Accordingly, the following is claimed:

1. A method of providing a custom orthodontic appliance for repositioning teeth of a patient comprising:

providing a computer interface device to an orthodontic practitioner;

providing automated orthodontic appliance manufacturing equipment;

producing a record of three-dimensional information from the mouth of a patient containing three-dimensional information of the shapes of the teeth of the patient and/or their positions in the mouth of the patient;

inputting data of the three-dimensional information into a digital computer and deriving with the computer, from the three-dimensional information, suggested tooth positions and orientations;

displaying images of the teeth in the suggested tooth positions and orientations for inspection by the orthodontic practitioner;

providing a capability for entering change data from the orthodontic practitioner into a computer indicating selected changes in the suggested tooth positions and orientations;

if change data is entered, recalculating with a computer, revised tooth positions and orientations in response to the change data;

if change data is entered, redisplaying, at the first location, images of the teeth in the revised tooth positions and orientations for inspection by the orthodontic practitioner;

entering commands from the orthodontic practitioner accepting the revised tooth positions and orientations;

processing data of the accepted tooth positions and orientations and of the three-dimensional information and designing a custom orthodontic appliance for the patient;

in response to digitized data of the designed custom orthodontic appliance, manufacturing an orthodontic appliance so designed that is configured to urge the teeth of the patient, when installed thereon, toward the revised tooth positions and orientations.

2. A method of providing a custom orthodontic appliance for repositioning teeth of a patient comprising:

providing a computer interface device to an orthodontic practitioner at a first location that includes one or more cites remote from an orthodontic appliance manufacturing facility at which a patient visits an orthodontic practitioner for diagnosis or treatment;

providing automated orthodontic appliance manufacturing equipment at a second location that includes one or more cites including the orthodontic appliance manufacturing facility;

at the first location, producing a record of three-dimensional information from the mouth of a patient containing three-dimensional information of the shapes of the teeth of the patient and/or their positions in the mouth of the patient;

inputting data of the three-dimensional information into a digital computer and deriving with the aid of a computer, from the three-dimensional information, tooth positions and orientations;

at the first location, providing a capability for entering data from the orthodontic practitioner into a computer indicating preferred tooth positions and orientations;

processing data of the tooth positions and orientations and of the three-dimensional information and designing a custom orthodontic appliance for the patient;

at the second location, in response to digitized data of the designed custom orthodontic appliance, manufacturing an orthodontic appliance so designed that is configured to urge the teeth of the patient, when installed thereon, toward the revised tooth positions and orientations.

3. A method of providing a custom orthodontic appliance for repositioning teeth of a patient comprising:

providing a computer interface device to an orthodontic practitioner at a first location that includes one or more cites remote from an orthodontic appliance manufacturing facility at which a patient visits an orthodontic practitioner for diagnosis or treatment;

providing automated orthodontic appliance manufacturing equipment at a second location that includes one or more cites including the orthodontic appliance manufacturing facility;

at the first location, producing a record of three-dimensional information from the mouth of a patient containing three-dimensional information of the shapes of the teeth of the patient and/or their positions in the mouth of the patient;

inputting data of the three-dimensional information into a digital computer and deriving with the computer, from the three-dimensional information, suggested tooth positions and orientations;

at the first location, displaying images of the teeth in the suggested tooth positions and orientations for inspection by the orthodontic practitioner;

at the first location, providing a capability for entering change data from the orthodontic practitioner into a computer indicating selected changes in the suggested tooth positions and orientations;

if change data is entered, recalculating with a computer, revised tooth positions and orientations in response to the change data;

if change data is entered, redisplaying, at the first location, images of the teeth in the revised tooth positions and orientations for inspection by the orthodontic practitioner;

at the first location, entering commands from the orthodontic practitioner accepting the revised tooth positions and orientations;

processing data of the accepted tooth positions and orientations and of the three-dimensional information and designing a custom orthodontic appliance for the patient;

at the second location, in response to digitized data of the designed custom orthodontic appliance, manufacturing an orthodontic appliance so designed that is configured to urge the teeth of the patient, when installed thereon, toward the revised tooth positions and orientations.

4. The method of claim 3 further comprising:

providing a digital communications link between the computer interface device at the first location and a digital computer at the second location;

transferring the record of three-dimensional information from the first location to the second location;

inputting the data of the three-dimensional information into the digital computer at the second location and deriving therewith the suggested tooth positions and orientations;

communicating digital data of the suggested tooth positions and orientations from the second location to the first location over the digital communications link;

communicating the digital change data from the first location to the second location over the digital communications link;

recalculating the revised tooth positions and orientations with the digital computer at the second location in response to the change data;

communicating digital data of the revised tooth positions and orientations from the second location to the first location over the digital communications link;

communicating the entered commands accepting the revised tooth positions and orientations from the first location to the second location over the digital communications link;

the processing of the data of the accepted revised tooth positions and orientations and of the three-dimensional information and the designing of the custom orthodontic appliance being carried out with the digital computer at the second location.

5. The method of claim 4 further comprising:

transmitting data of the design of the custom orthodontic appliance from the second location to the first location over the digital communications link;

displaying the images of the designed custom orthodontic appliance at the first location in response to the transmitted data thereof;

transmitting data the appliance modification data from the first location to the second location and entering the data into the digital computer at the second location;

redesigning the appliance with the digital computer at the second location in response to the transmitted appliance modification data;

transmitting data of the redesign of the custom orthodontic appliance from the second location to the first location over the digital communications link;

transmitting the entered commands accepting the redesign of the orthodontic appliance from the first location to the second location over the digital communications link.

6. The method of claim 3 further comprising:

at the first location, displaying images of the designed custom orthodontic appliance and the teeth of the patient in tooth positions and orientations produced by the appliance for inspection by the orthodontic practitioner;

at the first location, entering appliance modification data from the orthodontic practitioner into a computer indicating selected modifications in the proposed orthodontic appliance;

redesigning with a computer, a custom orthodontic appliance in response to the appliance modification data;

at the first location, redisplaying images of the redesigned custom orthodontic appliance and the teeth of the patient in tooth positions and orientations produced by the redesigned appliance for inspection by the orthodontic practitioner;

at the first location, entering commands from the orthodontic practitioner accepting the redesign of the orthodontic appliance; and

transmitting data from the first location to the second location in response to the entered commands accepting the redesign.

7. The method of any of claims 1 through 3 further comprising:

the manufacturing step includes manufacturing includes forming positioning jigs having surfaces thereon that conform to the shapes of the teeth of the patient.

8. The method of any of claims 1 through 3 further comprising:

the manufacturing step includes manufacturing includes forming a positioning jig having a surface thereon that conforms to the shape of one or more teeth of the patient; and

the method further comprises:

locating the jig on the patient with said surface conforming to the shape of the one or more teeth, positioning structure on the one or more teeth with the jig, and

bonding the structure so positioned to the tooth.

9. A method of providing and installing an orthodontic appliance to reposition the teeth of a patient to preferred positions in the mouth of the patient, the method comprising the steps of:

producing a model of the mouth of a patient at a treatment location, from which model three-dimensional information of the shapes of the teeth of the patient and/or their positions in the mouth of the patient can be derived;

transmitting the model from the treatment location to a production location;

at the production location, inputting the three-dimensional information into a digital computer and producing three-dimensional digital representations of a plurality of the teeth of the patient from the three-dimensional information input therein;

deriving with the computer, at the production location, from the three-dimensional representations, suggested relative tooth finish positions and orientations that define the three-dimensional shapes of each of the teeth of the plurality and/or their positions and orientations relative to each other in mutual occlusion in a pair of arches;

transmitting, from the production location to a computer terminal at a treatment location, digital data of the derived suggested tooth finish positions and displaying images of the teeth in the suggested relative tooth finish positions and orientations;

changing selected data of the relative tooth finish positions and orientations on the computer terminal at the treatment location and transmitting data of the changed relative tooth finish positions to the production location;

recalculating with a computer, at the production location, revised relative tooth finish positions and orientations resulting from the changed selected data thereof and further transmitting, from the production location to a computer terminal at a treatment location, digital data of the recalculated revised relative tooth finish positions and displaying the images of the teeth in the revised relative tooth finish positions and orientations;

manufacturing at the production location, in response to control signals containing three-dimensional information of the shapes of the patient's teeth and of the revised relative tooth finish positions and orientations, an orthodontic appliance having at least some surfaces thereof that conform to the shapes of the teeth of the patient, which appliance, when installed on the teeth of the patient by placing said surfaces thereof in conforming contact with corresponding surfaces of the patient's teeth, urge the teeth of the patient toward the revised relative tooth treatment positions; and

at the treatment location, installing the appliance on the teeth of the patient by placing said surfaces thereof in conforming contact with corresponding surfaces of the patient's teeth, and urging with the appliance the teeth of the patient toward the revised relative tooth treatment positions.

10. The method of claim **9** wherein:

the model is a three-dimensional physical model cast from a mold of the patient's teeth at the treatment location; and

the inputting is conducted by scanning the physical model at the production location and producing a high resolution, three-dimensional data file of the patient's teeth thereby.

11. The method of claim **10** wherein:

the scanning includes scanning the model with a laser and producing three-dimensional digital data of the surfaces of the patient's teeth thereby.

12. The method of claim **11** wherein the scanning includes:

scanning the model and producing a low resolution digital image thereby;

selecting data of the low resolution digital image data that conforms to portions of the low resolution image for consideration in determining tooth finish positions and appliance design;

scanning the model in accordance with the selected data to produce high resolution, three-dimensional images of at least portions of surfaces of the patient's teeth which contact other teeth or the appliance.

13. The method of any of claims 1 through 3 or claim 9 wherein:

the tooth finish position deriving and calculating steps include representing each tooth at least partially by its crown long axis located and oriented in three dimensions.

14. The method of claim 13 further comprising the steps of:

the tooth finish position deriving and calculating steps include calculating positions of cusps, ridges, grooves and tooth widths in three dimensions relative to the locations and orientations of the crown long axes of the teeth.

15. The method of any of claims 1 through 3 or claim 9 wherein:

the tooth finish position deriving and calculating steps include defining each tooth's torque angle, tip angle, rotation angle and position relative to others of the patient's teeth.

16. The method of any of claims 1 through 3 or claim 9 wherein:

the tooth finish position deriving and calculating steps include defining each tooth's in six degrees of freedom.

17. The method of any of claims 1 through 2 or claim 9 wherein:

the data changing step includes adjusting computer images of a tooth by changing a tooth's torque angle, tip angle, rotation angle or position relative to others of the patient's teeth by an orthodontist on a computer terminal at the treatment location.

18. The method of any of claims 1 through 3 or claim 9 wherein:

the manufacturing step includes manufacturing an appliance that includes brackets for connection to the teeth at calculated placement positions on the surfaces thereof and includes removable jigs having surfaces thereon that conform to the shapes of the teeth of the patient and connect to the brackets to position and orient the brackets relative to those surfaces, such that, when the jigs are connected to the brackets and the surfaces thereof are fit onto the teeth with the surfaces thereof conforming to the surfaces of the teeth, the brackets are supported at the calculated placement positions for bonding to the surfaces of the teeth.

19. The method of claim **18** wherein:

the orthodontic appliance manufacturing includes removably connecting each of the brackets to a corresponding one of the jigs; and

the method includes providing the appliance to the treatment location with brackets and jigs removably connected.

20. The method of any of claims **1** through **3** or claim **9** wherein:

the orthodontic appliance manufacturing includes depositing material in accordance with a calculated appliance design, layer by layer, until a three-dimensional object the size and shape of an orthodontic appliance or component thereof, or a negative form from which the appliance or component can be made, is defined by the deposited material.

21. The method of claim **20** wherein:

the material is selectively formed in each layer of a first portion of material that is removable chemically, thermally or mechanically, and a second portion that remains after removal of the first portion to form a solid object the shape of a custom orthodontic appliance or component thereof.

22. The method of claim **21** wherein:

the solid object is a pattern having said shape and the manufacturing further includes forming a mold with the use of the pattern and casting the orthodontic appliance or component thereof therein.

23. The method of claim **22** wherein:

the material is wax of two types, one forming said first portion and one forming said second portion, and the deposition thereof to selectively form the layers includes the selective jet printing of the layers to define a cross section of the object with said second portion forming the pattern and being surrounded by a removable medium formed of said first portion.

24. The method of claim **9** wherein:

the orthodontic appliance manufacturing includes forming bases for a plurality of brackets of a set from an integral sheet of base material, each base having an archwire support blank attached thereto, and cutting archwire slots in each of the archwire supports by supporting the sheet and moving a cutting tool relative thereto.

25. The method of claim **9** wherein:

the orthodontic appliance manufacturing includes cutting a curve in a form in the custom shape of an archwire, placing a wire length in the cut curve and heat treating the wire while held by the form to impart to the wire the shape of the cut curve.

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26. A method of making a custom orthodontic appliance comprising the steps of:

producing three-dimensional digital data defining shapes of the crowns of a plurality of the teeth of a patient;

by a jet printing method and in response to the three-dimensional digital data, directly or indirectly forming a custom orthodontic appliance having at least one three-dimensional surface thereof that is configured to matingly conform to at least a portion of the crown of a tooth of the patient.

27. The method of claim **26** wherein the forming of the custom orthodontic appliance by stereo lithography includes:

forming, by stereo lithography responsive to the three-dimensional digital data, an intermediate object having at least one surface defined by the shape of at least a portion of at least one of the crowns of the teeth of the patient; and

performing a molding process using the intermediate object to form a custom orthodontic appliance having at least one three-dimensional surface thereof that is configured to matingly conform to at least a portion of the crown of a tooth of the patient

28. The method of claim **27** wherein:

the forming of the intermediate object includes forming the intermediate object having a plurality of surfaces each defined by the shape of at least a portion of a different one of the crowns of the teeth of the patient; and

the performing of the molding process includes forming the appliance having a plurality of three-dimensional surfaces thereof configured to matingly conform each to at least a portion of the crown of a different one of the plurality of the teeth of the patient.

29. The method of claim **28** wherein:

the forming of the intermediate object includes forming a pattern of a plurality of brackets of the orthodontic appliance and using the pattern to make a mold thereof; and

the performing of the molding process includes investment casting a plurality of orthodontic brackets in the mold, each bracket having a three-dimensional surface thereon configured to matingly conform to at least a portion of the crown of one of the teeth of the patient.

30. The method of claim **26** wherein the forming of the custom orthodontic appliance by stereo lithography includes directly producing an orthodontic bracket by depositing by stereo lithography material from which the bracket is made in the shape of an orthodontic bracket having at least one three-dimensional surface thereof that is configured to matingly conform to at least a portion of the crown of a tooth of the patient.

31. Straightening the teeth of a patient with an orthodontic appliance made by the method of any of claims 26 through 30 and further comprising the steps of:

installing the custom orthodontic appliance on the teeth of the patient with the said surface matingly conforming to said portion of the crown of the tooth of the patient; and

through forces exerted on the tooth through the matingly conforming surface, moving the tooth in the mouth of the patient.

32. A method of directly or indirectly manufacturing an orthodontic appliance comprising:

producing digital data defining a three dimensional surface of an orthodontic appliance;

depositing material, in accordance with the digital data, layer by layer in a plurality of layers each constituting a two dimensional cross-section of a solid object having an edge defined by data of the three dimensional surface, the layers being stacked in a third dimension to form the solid object having a three dimensional surface defined by the data.

33. The method of claim 32 further comprising:

the solid object having the three dimensional surface is an orthodontic appliance having a surface defined by the three dimensional surface of the object.

34. The method of claim 32 further comprising:

using the solid object having the three dimensional surface to indirectly shape an orthodontic appliance having a surface defined by the three dimensional surface of the object.

35. The method of claim 34 wherein:

the solid object is a pattern having said shape and the manufacturing further includes forming a mold with the use of the pattern and casting the orthodontic appliance or component thereof therein.

36. The method of claim 32 wherein:

the material is selectively formed in each layer of a first portion of material that is removable chemically, thermally or mechanically, and a second portion that remains after removal of the first portion to form a solid object the shape of a custom orthodontic appliance or component thereof.

37. The method of claim 35 wherein:

the material is wax of two types, one forming said first portion and one forming said second portion, and the deposition thereof to selectively form the layers includes the selective jet printing of the layers to define a cross section of the object with said second portion forming the pattern and being surrounded by a removable medium formed of said first portion.

38. A method of manufacturing an orthodontic appliance comprising:

defining three-dimensional digital data of a custom orthodontic appliance;

providing bases for a plurality of brackets of a set on an integral sheet of base material, each base having a curvature approximately corresponding to the three dimensional shape of at least a portion of a crown of a tooth;

attaching an archwire support blank to each of the bases on the integral sheet; and

cutting archwire slots in each of the archwire supports by supporting the sheet and moving a cutting tool relative thereto.

39. The method of claim **38** further comprising:

separating each of the bases from the sheet.

40. A method of manufacturing an orthodontic appliance comprising:

defining three-dimensional digital data of a custom orthodontic appliance;

forming, in response to the data, in a shaping element a dental anatomical or orthodontic appliance shape; and

forming the an orthodontic appliance or appliance accessory to the shape with the shaping element.

41. The method of claim **40** wherein:

the forming of the shape includes forming a curve in the shaping element in the shape of an archwire; and

the forming of the appliance or appliance accessory to the shape includes placing a wire length in the cut curve and annealing the wire while held by the form to impart to the wire the shape of the cut curve.

42. A custom orthodontic appliance manufacturing system comprising:

an orthodontic appliance manufacturing machine at an orthodontic appliance manufacturing facility;

computer interface means remote from an orthodontic appliance manufacturing facility;

means for producing a record of three-dimensional information from the mouth of a patient containing three-dimensional information of the shapes of the teeth of the patient and/or their positions in the mouth of the patient;

means for inputting data of the three-dimensional information into a digital computer;

means for deriving from the three-dimensional information, suggested tooth positions and orientations;

the interface means including means for displaying images of the teeth in the suggested tooth positions and orientations;

means for processing data of the accepted revised tooth positions and orientations and of the three-dimensional information and designing a custom orthodontic appliance for the patient;

the machine being operative in response to digitized data of the designed custom orthodontic appliance to manufacture an orthodontic appliance so designed that is configured to urge the teeth of the patient, when installed thereon, toward the revised tooth positions and orientations.

43. The system of claim **42** further comprising:

means for entering change data indicating selected changes in the suggested tooth positions and orientations;

means for recalculating revised tooth positions and orientations in response to the change data;

the interface means including means for redisplaying images of the teeth in the revised tooth positions and orientations for inspection by the orthodontic practitioner and means for entering commands from the orthodontic practitioner accepting the revised tooth positions and orientations;

44. The system of claim **42** or claim **43** further comprising:

a digital communications link between the computer interface device and a digital computer at the orthodontic appliance manufacturing facility;

and wherein the means for inputting the data of the three-dimensional information into the digital computer is located at the orthodontic appliance manufacturing facility which further includes means communicating digital data of the suggested tooth positions and orientations from the orthodontic appliance manufacturing facility to the interface over the digital communications link.

45. The system of claim **42** or claim **43** wherein the means for producing the record of three-dimensional information from the mouth of a patient includes:

a low resolution optical scanner for producing a low resolution digital image of the shapes of the patient's teeth; and

a high resolution optical scanner producing three-dimensional images of at least portions of surfaces of the patient's teeth in response to a selection from the low resolution digital image.

46. The system of claim **42** or claim **43** wherein:

the interface includes means for providing controls to an orthodontic practitioner for inputting change data of torque angle, tip angle, or rotation angle information for individual teeth; and

the means for recalculating revised tooth positions and orientations in response to the change data is operative to recalculate the revised tooth positions and orientations in response to the input angle data.

47. A system for manufacturing an orthodontic appliance comprising means, including a programmed computer, for performing the method of any of claims **1** through **41**.

48. A system for manufacturing an orthodontic appliance comprising means, including a programmed computer, for facilitating the performance of the method of any of claims **1** through **41**.

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